transmitting. Therefore, we do not know if the eagle migrated farther north or remained to nest in central British Columbia. This was the only PTT marked bird that migrated out of the eastern Idaho-western Montana area.

Table 2. Summary of telemetry transmission data, blood lead levels, sex and age of 6 golden eagles captured in east central Idaho and tracked by satellite from winter 1995-96 through winter 1996-97.

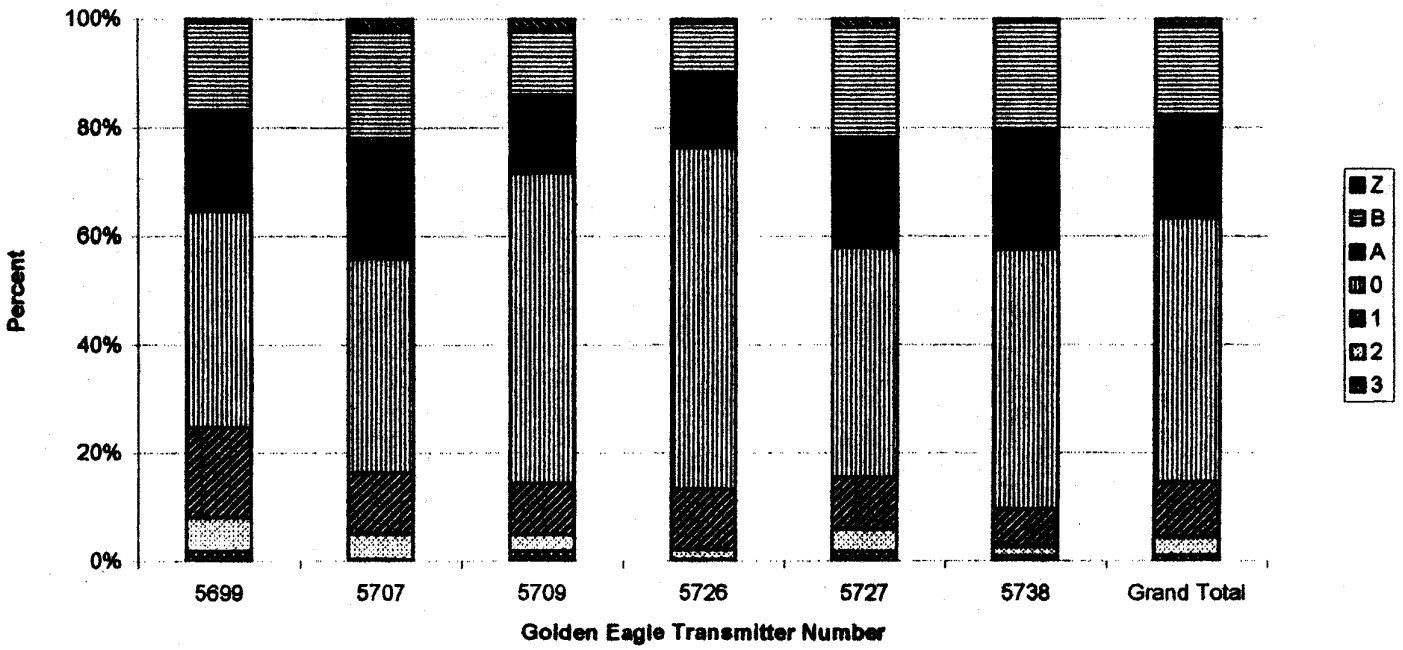
TRANSMITTER #	AGE	SEX	PB LEVEL (ppm)	DATES OF TRANSMISSION	MAXIMUM WINTER AND SUMMER RANGE WIDTH IN KM[1]	TOTAL # FIXES	% FIXES LC 1 – 3
5709	A	F	0.23	1/13/96-4/7/96	150	157	14.6%
5727	A	M	0.71	1/18/96-1/2/97	350	271	15.5%
5726	A	M	0.42	12/30/95-1/2/97	80	322	16.1%
5699	SA	M	0.22	1/18/96-5/13/96	150	192	24.5%
5738	SA	M	0.37	1/15/96-1/3/97	200	238	8.8%
5707	SA	F	0.39	1/8/96-11/26/97	160	252	16.7%

[1]Winter and summer range width is approximate and measured at the greatest distance between outermost points. It does not include distances covered during migration.

We captured and radio-tagged two adult male eagles. Male 5727, had the highest lead level of the 6 eagles tracked by satellite. He wintered in two distinct, but widely separated locations (350 km apart) in Idaho (Figure 4). One of these locations included the Lemhi and the Pahsimeroi Valleys, although the eagle spent more time in the Lemhi Valley. The other area was to the southwest, near Twin Falls, Idaho. Each wintering area was about 75 km in diameter.

During the spring, 5727 flew north 400 km to the area around Polaris, Montana (Figure 5). The eagle remained in this general area for the first two weeks in April. In late April, he began to drift southward again and all subsequent locations during the nesting season were scattered along the Continental Divide, south and west of Polaris (Figure 6). We assume that 5727 did not breed successfully in 1996 because these locations were widely dispersed. This eagle used a range during the breeding season at least 130 km wide. Eagle 5727 moved southward in the fall to the Twin Falls area along the same route he had taken in the spring (Figure 7) and spent most of that winter there.

Figure 1. Percentage of Location Estimates Determined by Satellite Telemetry that fell in each of 7 Location Classes. Data are presented by transmitter # for each Golden Eagle Monitored, as well as, for all Location Estimates Combined.



The other adult male eagle, 5726, was a year-round resident in the Lemhi Valley, although he made several short visits to the Pahsimeroi Valley, as well (Figure 8). He was the only resident eagle we tracked and had a winter range about 80 km long. During the nesting season and migration periods 5726 occupied an area only 50 km in diameter (Figures 9, 10, 11 and 12). This bird's summer range was entirely within his winter range. Unfortunately, we received the radio location data in mid-summer after young normally fledge from the nest, so we were unable to verify nesting by 5726 in 1996. However, in July we visited the area 5726 frequented most during the nesting season and spotted an adult male golden eagle marked with a backpack transmitter. This eagle, most probably 5726, was flying near a larger adult and an immature golden eagle. All three birds were near a known nesting territory in the upper end of the Lemhi Valley and it is probable that he nested successfully in this area.

We placed PTTs on two subadult males and one subadult female golden eagle. None of these birds were long-range migrants. The location estimates for the subadults were more widely scattered throughout their entire range than for adults. In addition, movement patterns of subadults and breeding adults were different, particularly during the breeding season. With the exception of the migration period, subadult eagles tended to be more wide-ranging, often moving more frequently to different locations and greater distances between satellite locations than adult birds (see Appendix B for movement patterns of individual eagles and Appendix C for monthly maps of location estimates for individual eagles). This difference in movement patterns was less obvious during the winter months.

One subadult male (5699) wintered in both the Lemhi and Pahsimeroi Valleys but also spent time in an adjacent valley in Montana (Figure 13). Eagle 5699 had a winter range about 150 km in width. This eagle's spring and summer movements overlapped his winter range (Figures 14, and 15). The PTT of this subadult bird failed in May. His range from 18 January 1996 through 13 May 1996 spanned approximately 150 km (Figure 16).

The other subadult male's winter movements (eagle 5738) were also approximately 150 km at the widest point (Figure 17). His winter range was similar to 5699's, which included the Lemhi Valley and southwestern Montana. However, 5738 was never located in the Pahsimeroi Valley. His spring, summer and fall movements overlapped the part of his winter range in Montana but not the part in Idaho (Figures 18, 19 and 20). The summer locations for 5738 were scattered more widely than those in the winter and consequently his year-round range spanned a distance more than 200 km in width (Figure 21).

The subadult female we studied (eagle 5707) spent more time in the Pahsimeroi and Upper Little Lost River Valleys than in the Lemhi Valley during the winter (Figure 22). Her winter range spanned about 160 km and, like the other nonmigratory eagles, her spring, fall and summer range overlapped her winter range (Figures 23,24, 25 and 26). 5707 did not visit the Pahsimeroi Valley during the summer.

Year-round home range areas of the adult golden eagles monitored were generally smaller than those of subadult eagles (Table 3). Use of only LCs 1-3 underestimated areas used by the birds because sample sizes were small within these categories. With the exception of eagle 5707, it also underestimated the number of concentrated use areas (clusters) within each golden eagle range. The number of clusters (LCs 3-0) within a use area varied from 8 for adult male 5709, to one for subadult female 5707. Use of only LCs 3-1 resulted in the identification of 2-3 clusters within each eagle home range.

Clusters identified within the east central Idaho study area during the winter were in areas of native shrub habitats. Winter ranges of most of the eagles overlapped spatially and sometimes temporally, as well. Winter ranges of eagles 5727, 5699, 5738 and 5707 were smaller than during the breeding season. Three of these birds were subadults and one was a non-nesting adult. The one resident adult male that we assume nested had a larger winter range than home range during the nesting season. No data were collected from the adult female, 5709 during the breeding season, so no comparison of range sizes could be made for this eagle.

Table 3. Summary of telemetry data (convex polygons) for location classes 3-0, based on data from 6 golden eagles from January 1996 through September 1997.

TM#	Range (ha) 90% 1-0	n	Range (ha) 90% 1-3	n	Maximum ha (convex polygon)	# clusters 3-1	# clusters 3-0
5709	54930	91	42,070	16	764,481	3	8
5727	73,910	70	38,140	24	557,148	2	4
5726	66,420	109	8,623	24	442,076	2	2
5699	112,800	93	60,160	34	415,246	2	4
5738	172,000	74	26,410	12	686,907	2	4
5707	561,900	82	124,800	25	1,115,259	2	1

DISCUSSION

The golden eagle use areas reported herein are larger than those reported by researchers in Idaho who used conventional telemetry (Marzluff et al. 1997, Dunstan et al. 1978). One possible explanation is that the previous studies have been conducted on eagles during the nesting season, or on resident birds. However,

location data obtained with the Argos satellite system cannot be interpreted in the same way as conventional telemetry data because so few satellite location estimates fall within the most accurate location classes (3-1). Generally, there is less error in conventional telemetry location data. Schueck et al. (1994) also reported golden eagle winter use areas determined by PTT location estimates to be larger, in most cases, than use areas determined by direct observations obtained in conjunction with conventional telemetry.

In spite of the error associated with PTT location estimates, the data are valuable for certain interpretations, since they can be used to infer general use areas and movements of individual eagles throughout the tracking period. In addition, these data are particularly useful for relative comparisons of use areas, movement patterns among eagles, and for monitoring individuals over large areas and for extended periods. For instance, we found year-round use areas of subadult golden eagles generally to be larger than those of adults, and subadults and nonbreeding adults to be somewhat nomadic. Schueck et al. (1994) reported similar results on eagles studied in the Snake River Birds of Prey area. We also noted that non-breeding season use areas did not necessarily overlap the home range used during the breeding season.

Golden eagles in the study area showed fidelity to wintering areas from one year to the next and although overall use areas were large, activity was generally concentrated in small areas of native shrub habitat at lower elevations. In fact, the most successful winter trapping areas were those sagebrush areas in which concentrations of black-tailed jackrabbits occurred. Previous research has reported similar habitat selection by wintering eagles, as well as, for resident birds (Marzluff et al. 1997, Craig et al. 1986). In addition, our data, as well as those collected by Marzluff et al. (1997), show that not only do eagles use the same areas from year-to-year, but that size and shape of those areas are often similar among years.

Although we have observed adult eagles (we assumed resident birds) to occasionally display undulating flights during the winter, wintering areas of the eagles overlapped and we trapped up to 8 eagles in a single day within the same general area. This implies that there is no territorial defense during the winter. Others have reported overlapping use areas during the nonbreeding season (Marzluff et al. 1997, Schueck et al. 1994).

Argos telemetry data for the 6 eagles studied indicated that the wintering population of eagles in the study area comprises local resident birds, long-distance migrants and regional residents that range over large portions of eastern Idaho and western Montana. The only area used in common by *all* of the eagles was the Lemhi Valley during the winter.

The Pahsimeroi and Lemhi Valleys were included in the winter ranges of five of the 6 golden eagles tracked during winter 1995-96. However, only two birds, 5699 and 5707 (both subadults), were located frequently in both valleys. These findings are supported

by our recapture data that indicate a limited exchange of eagles between the two valleys. Few PTT location estimates from any of the 6 eagles were from the Birch Creek Valley.

Golden eagles show fidelity to wintering and nesting areas and also follow the same migration routes from one year to the next (Marzluff et al. 1997, Brodeur et al. 1996, Craig and Craig 1996, L. Schueck 1994). If this is true for the 6 golden eagles that we studied, the Argos telemetry data collected in 1995-1996 can be used to infer the areas frequented by these birds prior to their capture. Therefore, we assume that the elevation in blood lead levels found in all 6 of the eagles, probably resulted from exposure to lead within the annual ranges we have documented.

Therefore, adult male 5726, a year-round resident of the study area, was most likely exposed to lead within the Upper Lemhi Valley. Similarly, the four eagles that were "regional residents" probably were exposed to lead either in, or within several hundred kilometers, of our study area. The single long-range migrant may have been exposed to lead on its winter range in our study area in Idaho, on its summer range, or along its migration route into Canada.

MANAGEMENT IMPLICATIONS

As a result of this research we have determined that:

- the study area is used regularly by wintering golden and bald eagles;
- the wintering golden eagle population comprises resident nesters, regional residents, and migrants;
- the bald eagles in the study area are primarily winter residents with only three known pairs of bald eagles resident in the study area;
- many of the bald and golden eagles wintering in east central Idaho have elevated lead levels in their blood;
- wintering bald eagles in the study area have elevated mercury levels;
- contaminant levels in most of the eagles sampled are sublethal;
- exposure to lead contaminants may be chronic;
- the specific effects of sublethal, chronic exposure of lead to individual eagles, as well as the eagle population at large is unknown;
- specific sources and pathways of lead contamination are yet to be determined;
- live prey within wintering or natal ranges of golden eagles are probably not the avenue of lead contamination to wild golden eagles;
- lead contamination is acquired locally/regionally by some eagles;
- lead contamination of golden eagles in western North America is probably a pandemic phenomenon.

MANAGEMENT RECOMMENDATIONS

1. Continue to monitor blood lead levels in wintering golden eagles to provide further insight into long-term trends and threats to golden eagle populations. Recapture data are particularly important because they allow the tracking of individual eagles through time.

2. Fund research to monitor the movements and fates of individual golden eagles with and without elevated lead levels over long periods of time (reproduction, mortality, etc.) via satellite telemetry. Such long-term data are the key to determining the affects of sub-lethal lead contamination on eagle populations, as well as, the geographic source of the lead.

3. Fund research to conduct DNA analysis on blood samples currently being stored from this study. We have samples from nestling eagles in our study area, an eagle from Alaska that wintered in our study area, the eagles whose movements we followed via satellite and samples from eagles from the Snake River Birds of Prey Area. DNA analysis of these samples would help determine the genetic relationships of the birds wintering in east central Idaho and possibly, the areas from which they originated. These data could be compared to data already collected in this study, and used to determine if there is a correlation between related birds and contaminant levels (e.g., do more eagles that are regional residents have elevated lead levels than eagles from Alaska?).

4. Eagles rely on the native shrub habitats where jackrabbits, an important prey base, occur. Management of golden eagle populations should include protection of these areas.

5. Researchers have recently reported downward trends in golden eagle populations. It is important to monitor golden eagle populations to determine if this trend continues.

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